UNIFIED PROBABILISTIC FRAMEWORK FOR PREDICTING AND DETECTING SEIZURE ONSETS IN THE BRAIN AND MULTITHERAPEUTIC DEVICE

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A method and an apparatus for predicting and detecting epileptic seizure onsets within a unified multiresolution probabilistic framework, enabling a portion of the device to automatically deliver a progression of multiple therapies, ranging from benign to aggressive as the probabilities of seizure warrant. Based on novel computational intelligence algorithms, a realistic posterior probability function P (St|x) representing the probability of one or more seizures starting within the next T minutes, given observations x derived from IEEG or other signals, is periodically synthesized for a plurality of prediction time horizons. When coupled with optimally determined thresholds for alarm or therapy activation, probabilities defined in this manner provide anticipatory time-localization of events in a synergistic logarithmic-like array of time resolutions, thus effectively circumventing the performance vs. prediction-horizon tradeoff of single-resolution systems. The longer and shorter prediction time scales are made to correspond to benign and aggressive therapies respectively. The imminence of seizure events serves to modulate the dosage and other parameters of treatment during open-loop or feedback control of seizures once activation is triggered. Fast seizure onset detection is unified within the framework as a degenerate form of prediction at the shortest, or even negative, time horizon. The device is required to learn in order to find the probabilistic prediction and control strategies that will increase the patient's quality of life over time. A quality-of-life index (QOLI) is used as an overall guide in the optimization of patient-specific signal features, the multitherapy activation decision logic, and to document if patients are actually improving.
